The competitiveness of the Portuguese economy: A view from a composite indicator

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Abstract
This article analyses the competitive conditions in Portugal using a new composite competitiveness indicator (ICC) that combines annual cross-country aggregated data on a set of competitiveness-related variables. The indicator uses a simple metric to measure the gap of each country comparing to the best performer on each competitiveness-related variable considered, within the set of European Union Member-States. The ICC provides a comprehensive view of the relative evolution of the Portuguese competitiveness vis-à-vis the other EU countries over the period of 1995-2020. Despite significant improvements in the last years, the levels of the indicator are similar to those observed in 1995. Portugal ranks in 21st position in the EU but records the greatest progress among this reference group, as compared to 2007. The indicator is not affected by the disturbances caused by the COVID-19 pandemic on economic data and the Portuguese competitive conditions do not seem to have been altered by this shock. (JEL: O47, O52)

1. Introduction

Economic policy debate systematically revolves around the need to act on the determinants of long-term growth. However, these determinants are numerous and interact in a complex way. Aspects like the quantity and quality of inputs, especially human capital and innovation, the functioning of markets and the quality of institutions are typically part of this list. In addition, elements related to social cohesion and distribution of income have also been highlighted as important drivers of long-term economic growth.

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In Portugal, the discussion on long-term economic growth and structural reform is also present and it is exacerbated by the relatively disappointing performance of the economy over the last decades. In this vein, Banco de Portugal (2019) analyses the real convergence process in the European Union (EU) and the relative performance of Portugal's GDP per capita over the period 1960-2018. The analysis shows that the process of real convergence of the Portuguese economy has halted in the last 25 years. In addition, Amador and Santos (2020) estimates a common dynamic stochastic production frontier for the EU countries in the period 1990–2017 and disentangles the total contribution of inputs' accumulation and total factor productivity to GDP growth. Results reflect a modest performance of the Portuguese economy along the last decades, particularly in terms of the contribution of efficiency developments. Nonetheless, the Portuguese economy has undergone several transformations and adopted a comprehensive set of structural reforms, whose impact is probably still not fully visible. This situation makes it key to monitor competitiveness conditions in the Portuguese economy relatively to other European countries, and identify dimensions where there is under performance.

The objective of this article is to discuss competitiveness developments in the Portuguese economy using a composite indicator. Our analysis focuses on Portugal but, given its relative nature, the indicator can be replicated and compared across all reference countries. This work should be taken as a contribution for the debate and there is ample room for improvements going forward. For example, as they become available, different sets of indicators may be incorporated and alternative weighting procedures may be adopted.

Competitiveness is a diffuse concept, and its quantification encompasses a very wide range of areas. Therefore, any attempt to measure it requires many indicators of different types. Such multidimensional problem poses significant challenges, notably in terms of aggregating information and communicating a straightforward message.

The classic way of assessing competitive conditions relies on scoreboards that compare levels of relevant indicators for several countries, but in recent years composite indicators became popular tools to assess multi-dimensional economic phenomena. A growing number of international organizations has been developing composite indicators on various economic domains, making them part of the policy debate at both national and international levels. Examples are the Global Competitiveness Index published by the World Economic Forum (WEF 2019), the Product Market Regulation index and the Employment Protection Legislation index, both published by the OECD (Vitale *et al.* 2020 and OECD 2013), as well as the Doing Business Report, published by the World Bank (World Bank 2020).

An interesting example of a competitiveness composite indicator is Huemer *et al.* (2013). This paper presents an index that captures institutional and price competitiveness dimensions, covering 36 countries from 1990 to 2009, arranged along three groups (16 EMU countries, 10 non-EMU EU countries and 10 other OECD countries). It concludes that the individual components of institutional competitiveness have developed heterogeneously among EMU Member-States and that an uneven integration within the EU Single Market may play a role in this result. Our article differs

from Huemer *et al.* (2013) in terms of the scope of indicators, the reference group of countries and in the method used to test the robustness of the weighting procedure. In the latter dimension, we randomize weights of dimensions and individual indicators while Huemer *et al.* (2013) uses a factor decomposition analysis to show that the baseline assumption of uniform weights is justified.

A very important aspect to keep in mind is that countries undergo structural reforms simultaneously. Therefore, it is necessary to define a measure that compares countries' relative performance, for example in terms of distances to the best performer in a reference group. Without such benchmark, i.e, if results just reflect the path of the underlying indicators in a specific country, conclusions are misleading. Improvements in an indicator in a given country should only translate into higher competitiveness if they are stronger than those recorded by the other countries in the benchmark group. A composite indicator of competitiveness also requires that related indicators are converted into a common metric, strictly comparable across countries. To address these aspects we normalize the data by setting the distance to the best performer, as a percentage of the interval between best and worst performers. This empirical strategy is quite useful in the context of the COVID-19 pandemic. Although most macroeconomic variables faced sharp swings due to the pandemic, cross country comparisons in terms of distance to the best performer remain valid.

Another relevant aspect concerns the weighting of individual indicators in order to produce a single competitiveness indicator. Results may differ according to the choice of weights. To address this caveat, we randomize weights of basic indicators and recalculate the composite indicator for each draw. The interquartile range of the resulting distribution of values, in each moment, may be interpreted as a robustness interval around a baseline formulation with uniform weights.

Taking all the above concerns into consideration, data availability limitations inevitably arise. Identifying indicators with a long time span that are also strictly comparable for all reference countries is challenging. To fulfil these requisites we do not consider some potentially interesting dimensions and/or indicators of competitiveness.

Overall, composite competitiveness indicators (like the one used here) present both advantages and shortcomings. Advantages concern the comprehensiveness of dimensions covered, as well as their relative nature and temporal consistency. Shortcomings relate to restrictions on the set of eligible indicators and impossibility of identifying the most suitable set of weights.

The article is organized as follows. In the next section we describe the structure of the composite competitiveness indicator (ICC) and discuss the methodological options underlying its construction. We briefly present the selected competitiveness dimensions, the statistical requirements for selecting the indicators in each dimension, and the corresponding statistical sources. Next, we present the metric used to set the distance to the best performer and the weights used to aggregate information into a single indicator. Weighting is an important feature, thus we also discuss the procedure adopted to assess robustness of results under different options. Section 3 presents the results and is organized along three blocks. Firstly, we present the path of the ICC, its main dimensions and their contribution to yearly changes. Secondly, we compare results with

those for other EU countries, which set the benchmark regarding best performance in each variable. Thirdly, we compare the path of the ICC with that of relative labour productivity and relative GDP per capita, thus establishing an association with these two key outcome variables. Section 4 presents some final remarks.

2. Methodology

The competitiveness indicator presented in this article follows the practices recommended for the construction of composite indicators, as discussed in OECD and European Commission (2008). Those guidelines make it possible to maximize relevance, transparency and robustness of results. The quality of a composite indicator depends on the set of variables chosen, which determines its ability to capture a multidimensional phenomenon, and on the methodological procedures. The options underlying its calculation are also decisive for the outcome as they determine the degree of transparency and robustness of the indicator itself. This section briefly presents the rationale underlying the choice of the competitiveness dimensions that are part of the ICC, as well as operational aspects, in particular those concerning data normalization, weighting and aggregation.

2.1. Competitiveness dimensions

As thoughtfully pointed out in OECD and European Commission (2008), "*what is badly defined is likely to be badly measured*". Therefore, the first step towards the creation of an indicator that assesses a country's competitiveness is to clarify the definition and discuss differences relatively to other indicators.

Competitiveness is a diffuse and complex concept, with no consensual definition. A possibility is to define it in relative terms (with respect to competitors) and associated with a country's ability to use and combine available resources and skills to produce and sell goods in international markets, to generate wealth in a sustainable way and ensure high living standards for its citizens. In contrast, productivity is a measure of economic efficiency. It measures the way resources of an economy (e.g., labour, intermediate products, capital) are converted into final products by firms, industries and the economy as a whole (CPP 2019).

Competitiveness and productivity are often used interchangeably. For example, Porter (1990) states that the only meaningful concept of competitiveness in a country is national productivity. Differently, the Global Competitiveness Report by the World Economic Forum defines competitiveness as the set of institutions, policies and factors that determine the level of productivity of a country. In this perspective productivity comes out as an outcome variable of upstream competitiveness conditions. Finally, Atkinson (2013) states that productivity growth enables competitiveness, especially if it is concentrated in tradable sectors.

To construct our competitiveness indicator we choose four broad dimensions, namely: i) Macroeconomic stability and income distribution; ii) Education and innovation; iii) Investment and infrastructure and iv) Institutions and markets. Each

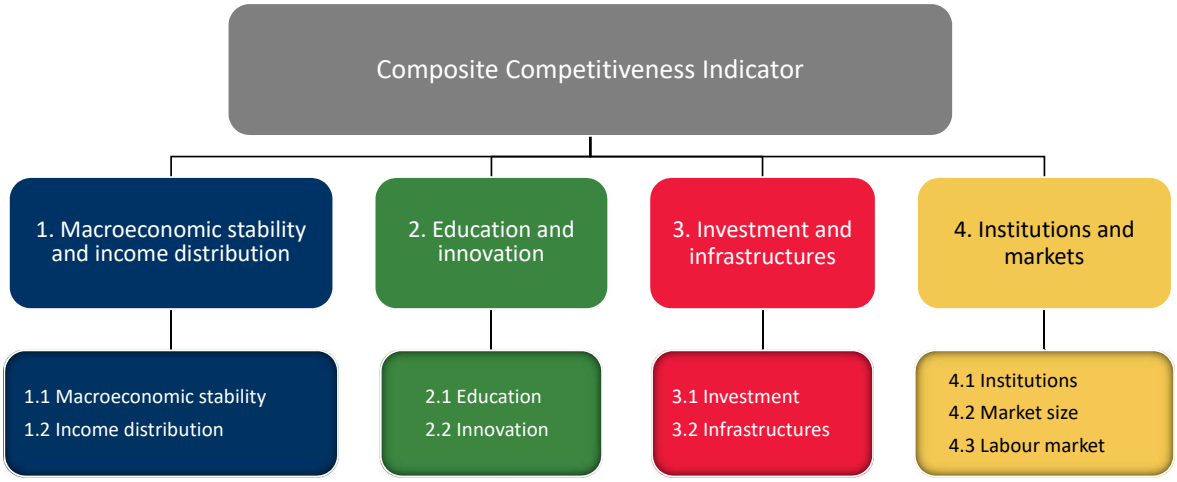

FIGURE 1: Structure of the composite competitiveness indicator

of these dimensions is subdivided into pillars that represent the topics of interest. Accordingly, the composite indicator considers four dimensions broken down along a total of nine pillars, as presented in Figure 1.

Starting from this structure, we select a set of relevant indicators for each pillar considered. Two basic criteria were established for the selection of the indicators: i) international comparability, in particular being available for the set of EU Member-States, and ii) availability of data for the period 1995-2020. This long time horizon is warranted to identify structural transformations that impact competitiveness conditions. Basing on these criteria, 25 indicators were selected and grouped into their correspondent pillar/dimension. The list of indicators is presented in Table 1.

For some indicators there is no information for all EU countries, mostly in the early years of the sample. Although the methodology accommodates this situation, since it only relies on the identification of the best and worst performances in each indicator at each moment of time, we used basic imputation techniques to estimate this small set of missing values and obtained a balanced information panel for the time horizon under analysis. Nevertheless, our data requirements made it unfeasible to use several indicators that, a priori, would be taken as relevant for the composite competitiveness indicator. Appendix A presents a list of indicators that were considered, but not included in the analysis.

2.1.1. Macroeconomic stability

It is widely acknowledged that the prevailing macroeconomic conditions strongly influence the decisions of economic agents, thus shaping long-term structural conditions. For example, whenever national savings are lower than investment decisions, this leads to current account imbalances and external financing needs. The persistence of these imbalances is associated to firms', households' and public indebtedness, it undermines their future financing capacity and may even lead to a sudden stop in external financing and a current account crisis. Subsequent effects, such as contractionary fiscal policies and higher market financing interest rates penalize

Dimension	Pillar	Indicator	Source
1 Macro stability & income distribution	1.1 Macro stability	1.1.1 Net savings (% GDP)	Eurostat
		1.1.2 Government balance (% GDP)	Eurostat
		1.1.3 Public + private debt (% GDP)	Eurostat
		1.1.4 Unemployment rate	Eurostat
	1.2 Income distribution	1.2.1 Last decile income (% total)	WID
		1.2.2 Gini coefficient	WID
2 Education & innovation	2.1 Education	2.1.1 Average number of schooling years	World Bank
		2.1.2 Active pop with tertiary educ (% active pop)	ILO
	2.2 Innovation	2.2.1 R&D expenditure (% GDP)	Eurostat
		2.2.2 Employees on R&D (FTE, % employment)	Eurostat
3 Investment & quality of infrastructure	3.1 Investment	3.1.1 Adjusted GFCF (% GDP)	Eurostat
		3.1.2 Capital per worker	EC-AMECO
	3.2 Quality of infrastructure	3.2.1 Density rail	World Bank
		3.2.2 Density roads	World Bank
		3.2.3 Nb internet users (% pop.)	World Bank
		3.2.4 Energy dependence ratio	Eurostat
4 Institutions & markets	4.1 Quality of institutions	4.1.1 Government efficiency	World Bank
		4.1.2 Quality of regulation	World Bank
		4.1.3 Rule of law	World Bank
		4.1.4 Control of corruption	World Bank
		4.1.5 Liberty of speech and responsibility	World Bank
		4.1.6 Political liberty and absence of violence	World Bank
	4.2 Market dimension	4.2.1 Degree of openness	Eurostat
	4.3 Labour market	4.3.1 Long-term unemployment rate	Eurostat
		4.3.2 Age dependency ratio	World Bank

TABLE 1. Sub-indicators of the composite competitiveness indicator
Note: WID stands for "World Inequality Database".

investment decisions, thus hindering capital accumulation and future economic growth. In short, countries with no macroeconomic imbalances are more competitive as they offer an investment-friendly environment and reinforce confidence of economic agents.

Two additional points are worth making. Firstly, although the unemployment rate is mainly an indicator of the cyclical position of the economy, it also signals the magnitude of macroeconomic imbalances. In addition, it is widely acknowledged that unemployment is a major source of poverty and inequality, thus affecting social capital and long-term economic growth. Therefore, we take this indicator aboard in this pillar. Nevertheless, the explanation above makes it clear that the unemployment rate could also be part of the income distribution pillar. The fact that this variable overlaps macroeconomic stability and income distribution pillars is a strong reason to take them both under the same competitiveness dimension. Secondly, price stability, defined in the euro area as an inflation rate of 2 per cent over the medium term, is also an important indicator of macroeconomic stability. Although inflation recently became a worldwide concern, it has been kept at very low levels during the past decades, notably in the euro area. Therefore, we do not consider this indicator in the current version of the ICC. Even so, it should be pointed out that inflation differentials among countries that share the same currency translate directly into changes in price competitiveness, while for other

countries exchange rate depreciations may compensate the impact of higher inflation. In fact, in the period 1995-2020, some non euro area EU countries recorded relatively high inflation rates.

Overall, the set of indicators selected to monitor this pillar are: i) net savings as percentage of GDP; ii) fiscal balance as a percentage of GDP; iii) public and private debt as percentage of GDP and the unemployment rate.

2.1.2. Income distribution

Inequality in income distribution became an important part of economic debate and several international organizations put this topic in parallel with other variables used to assess competitiveness. Inequality in income distribution is a reflection of many factors, including unemployment, underemployment and precariousness, and it represents a major obstacle to economic growth. Rising inequality weakens competitiveness conditions because it limits access to health and education, and greatly increases the risk of social instability. The indicators selected to monitor this pillar are: i) income share held by the highest 10 per cent earners as a percentage of total pre-tax national income and ii) the Gini coefficient.

2.1.3. Education

There is a wide agreement that workers' education and skills are one of the main drivers of long-term productivity and GDP growth (Criscuolo *et al.* 2021). Skilled workers are more adaptable to technological changes and better equipped to cope with shocks by switching to new activities. This is especially important in a context where overall technological progress, particularly digitalization, allow for the international trade of services, thus introducing competition in many segments of the labour market. In addition, digitalization has been accelerating the automation of routine tasks, leading to a greater substitution away from labour.

Empirical literature on the positive impact of education on productivity and growth is numerous. One important study that covers several countries is Black and Lynch (1996) and examples of research applied to the Portuguese case are Gouveia *et al.* (2019) and Fernandes (2019). The indicators selected to monitor the evolution in this pillar are: i) average number of years of schooling and ii) working age population with tertiary education as a percentage of total working age population. It is important to recall that these indicators do not capture aspects related to the quality of the education system. As it is often the case, we measure formal qualification levels and not existing skills.

2.1.4. Innovation

Innovation and R&D are critical competitiveness levers. Innovation enables the introduction of new or improved products, services or production processes within firms (e.g. Jorgenson *et al.* 2008 and Balasubramanian and Sivadasan 2011). Moreover, innovation has positive externalities, favouring knowledge transfer and technological upgrades among sectors and firms (e.g. Gersbach and Schmutzler 2003 and Bloom

et al. 2013). In the Portuguese case, according to Fernandes (2019), higher R&D personnel leads to labour productivity growth and has a significant effect on total factor productivity. The indicators selected to monitor the evolution in this pillar are: i) R&D expenditure as a percentage of GDP and ii) R&D personnel as a percentage of employment. As mentioned above for the case of education, these indicators do not capture the actual results of the innovation process.

2.1.5. Investment

The accumulation of productive capital is an important driver of competitiveness. It allows for the incorporation of new technologies into the production process and the expansion of the productive capacity of firms. Higher capital per worker (capital deepening) typically mirrors the adoption of new technologies. The literature on the relationship between investment and growth is also vast. Examples of such studies are Dougherty and Jorgenson (1997) and Jorgenson *et al.* (2008), which conclude that, for a wide range of countries, investment and capital accumulation are the main sources of growth. Although there are different strands of research and diverse results, it is often referred that some types of investment are relatively more productive than others. For example, investments in buildings and structures are arguably relatively less productive than those associated to new technologies (i.e. automation, intellectual property, R&D or ICT). These investments foster efficiency and innovation, as discussed in Stundziene and Saboniene (2019) and Hall *et al.* (2010).

Therefore, to proxy the quality of investments, one indicator selected for this pillar is the adjusted gross fixed capital formation (GFCF), which excludes investment in construction and transport material. The indicators selected to monitor the evolution in this pillar are: i) adjusted GFCF as a percentage of GDP and ii) capital per worker.

2.1.6. Infrastructures

The quality of infrastructures, for example in transports systems, energy and telecommunications, is a key element to foster the competitiveness of firms. Transport costs shape economic activity and international trade, while affecting the mobility of workers. More broadly, according to Munnell (1992) and Esfahani and Ramirez (2003), public investment in infrastructure has a positive effect on economic growth. The indicators selected to monitor the evolution in this pillar are: i) railway density per Km^2; motorway density per Km^2; iii) energy dependence, defined as net imports as a percentage of total energy consumption, and iv) number of individuals using the internet as a percentage of total population.

As pointed out in other pillars, the quality of the services listed and their cost are not taken into account. In addition, indicators on port and airport networks should be considered, but they did not meet the requirements defined in terms of comparability and period for analysis. Moreover, given the presence of non-coastal countries in the benchmark group, the use of port indicators would distort results.

2.1.7. Institutions

The quality of institutions is another important dimension of competitiveness. This pillar incorporates aspects typically seen as prerequisites for investment and the efficient functioning of markets. The literature that links institutions and economic growth is again large. A thoughtful historical perspective is given by North (1989). For the Portuguese economy, Arnold and Barbosa (2015) found evidence of a significant relationship between the total factor productivity of firms and a set of policy variables. The authors conclude that more administrative requirements to open a business, a broader coverage of collective bargaining agreements, greater time requirements for compliance with tax obligations and a higher number of processes needed to enforce a contract are associated with lower productivity.

There is a comparatively larger number of indicators in this pillar because the nature of the underlying phenomenon is diverse. The type of indicators used is also subject to criticism because it is based on perceptions and not data on observed outcomes. The Worldwide Governance Indicators published by the World Bank reflect perceptions on the ability of the government to formulate and implement sound policies and regulations, as well as the credibility of its commitment to such policies. Moreover, we take aboard perceptions on the quality of the civil service and its degree of independence from political pressures, in particular the quality of contract enforcement, property rights, the police and courts, as well as the likelihood of crime and violence. Finally, we consider perceptions of the extent to which citizens are able to participate in the selection of their government, as well as freedom of expression, freedom of association, and a free media. The indicators selected to monitor the evolution in this pillar are: i) government effectiveness; ii) regulatory quality; iii) rule of law; iv) control of corruption, v) voice and accountability and vi) political stability and absence of violence/terrorism.

2.1.8. Market size

This pillar takes account of the dimension of the market available for firms in a country. Economies that are more integrated in the global markets through international trade of goods and services have a larger pool of potential clients. In addition, these firms are subject to stronger competition, which tends to bring about a positive impact on competitiveness. The single indicator selected to monitor the evolution in this pillar is the degree of openness, computed as the sum of export and import flows as a percentage of GDP.

2.1.9. Labour market

Labour market efficiency is usually considered an important driver of aggregate productivity and competitiveness, in the sense that it should promote an efficient allocation of resources across sectors and firms. According to Bräuninger and Pannenberg (2002), there is empirical evidence supporting the thesis that an increase in unemployment reduces long-term productivity. Taking a different angle, Shekhar and Ebeke (2016) concluded that the ageing of the population reduces labour productivity

growth, mainly due to its negative impact on total factor productivity. The indicators selected to monitor the evolution in this pillar are: i) long-term unemployment rate and ii) age dependency ratio (share of non-working age population relative to working age population).

As already pointed out, some indicators could be used in different pillars. It is not strange that such overlap exists because the economic system is intrinsically integrated. For example, the long-term unemployment rate is taken as part of the labour market pillar, but it also relates with macroeconomic stability, income distribution and education. In the latter perspective, the lower the education level of individuals, the narrower the range of positions they can successfully apply to. Conversely, long unemployment spells decrease the likelihood of re-entering the labour market because individuals depreciate their skills.

2.2. Normalization of indicators

Combining a broad set of competitiveness indicators into a simple and intuitive index requires the prior normalization of the data in order to establish a metric and to eliminate scale effects. Given the characteristics of the indicators and the ultimate goal of having a simple, transparent and easy to communicate composite competitiveness index, we chose the so-called "min-max" normalization method.

The "min-max" method normalizes all indicators i into the same range, from 0 (least competitive) to 1 (most competitive), thus overcoming obstacles from combining indicators with different original scales. For each indicator series x_i, the "min-max" transformation takes the distance of country p relative to the best performing country (among EU countries) in year t, normalizing this distance by the amplitude between the best and worst performers in the respective indicator in that year:

$$I_{ip}^{t} = 1 - \frac{max_p(x_i^t) - x_{ip}^t}{max_p(x_i^t) - min_p(x_i^t)} \tag{1}$$

Needless to say that the best performance ($max_p(x_i^t)$) or the worst performance ($min_p(x_i^t)$) may be associated to the highest or lowest values, depending on the indicator. The transformation enables comparisons over time but it is sensitive to the existence of outliers. To bypass this situation, equation 1 is adjusted in order not to consider the maximum and minimum of each indicator in each year, but its 90th and 10th percentiles instead, when ordered from the worst to the best performer[1]:

$$I_{ip}^{t} = 1 - \frac{P90_p(x_i^t) - x_{ip}^t}{P90_p(x_i^t) - P10_p(x_i^t)} \tag{2}$$

1. The use of the 10th and the 90th percentiles implies that for countries in the first and last decile, the indicator I_{it} will take values equal to 0 or 1, respectively.

2.3. Weights and aggregation

After normalizing the set of selected competitiveness-related indicators to be included in the composite indicator, variables must be aggregated into a single index. For this purpose a simple weighting scheme is used, as presented in equation 3, where D and n stand for the number of dimensions and indicators inside each dimension, respectively. The choice of weights for each dimension d and indicator i, as listed in Table 1, is always a discretionary decision with impact on results. The baseline option was to assign the same weight to each dimension and the same weight to each indicator within each dimension. That is useful to avoid overvaluation of dimensions with a larger number of indicators (such as in dimension "Institutions & markets").

$$ICC_p^t = \sum_{d=1}^{D} \frac{1}{D} \left[\sum_{i=1}^{n} \frac{1}{n} \left(1 - \frac{P90_p(x_i^t) - x_{ip}^t}{P90_p(x_i^t) - P10_p(x_i^t)} \right) \right] \tag{3}$$

There is no obvious solution to overcome the discretion in the weighting process. In order to achieve robustness of the results we carried out a complementary exercise where random weights (taken from a uniform distribution) are assigned to each dimension and, at the lower level, also randomly distributed to each of the indicators within each dimension. We recompute the ICC for 1000 random draws of the weights and obtain a distribution for the level of the indicator in each year. Next, we take the first and third quartiles of this distribution, in each year, and those numbers are used to define robustness bands for the indicator. Such robustness bands and the median of the distribution are presented in parallel with the baseline indicator. Appendix B presents the same robustness exercise for each dimension of the composite indicator.

3. Results

This section presents the path of the ICC for Portugal, its four dimensions and their contributions to yearly changes, comparisons with other countries, as well as comparisons with the path of relative productivity per worker, relative productivity per hour worked and relative GDP per capita.

3.1. The composite competitiveness indicator

Figure 2 presents the ICC in the period of 1995-2020, as well as the median, first and third quartiles of the distribution generated by the randomization of weights along the four dimensions and indicators inside each dimension. The ICC signals a modest path for competitiveness in the period under analysis. The indicator consistently stays close to or below 0.3 in a scale with a maximum of 1. The ICC presented a downward trajectory until 2007. In 2008 and 2009 the indicator slightly recovered but this was interrupted in the period 2010-2011. Finally, between 2014 and 2020 there was a steady recovery, placing the indicator at levels similar to those existing in 1995. It is worth highlighting

that results for 2020, which reflect the early impact of the COVID-19 pandemic, show a rise in the ICC, signalling that this shock may not have hurt the competitiveness of the Portuguese economy in its first year.

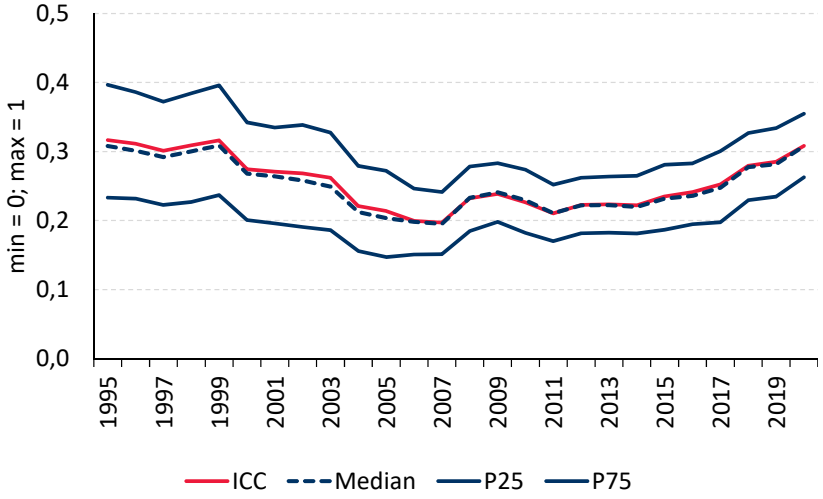

FIGURE 2: Composite competitiveness indicator

Note: The ICC is computed with uniform weights for each dimension and for each indicator inside each of them. The median, and the percentiles P25 and P75 are obtained from the distribution of the indicator that results from its calculation with 1000 random draws of weights, using a uniform distribution, both for its four dimensions dimensions and for the indicators that compose them.

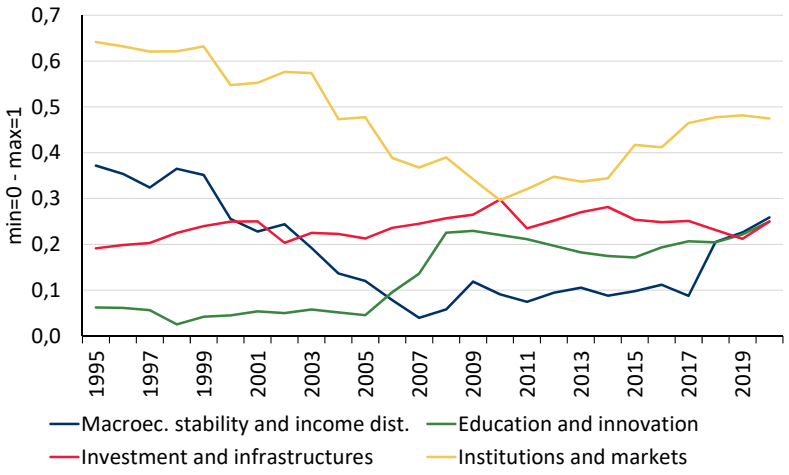

FIGURE 3: Dimensions of the composite competitiveness indicator

Figure 3 presents the path of the four dimensions of competitiveness that compose the ICC. Institutions and markets is the dimension with the highest level among the four considered. Despite the very strong decrease observed until 2010, there was a partial recovery up to 2020, placing the level of the indicator in this dimension slightly below 0.5. The levels observed for the other three dimensions in 2020 are quite similar and above 0.2. Nevertheless, their path taken since 1995 was quite different. The macroeconomic stability and income distribution dimension deteriorated sharply

until 2007, reaching very low levels, slightly improved in the following two years and improved markedly after 2017. The dimension of investment and infrastructures recorded a mild positive trend until 2010, receded in the following year, in connection with the Portuguese economic and financial assistance program, and recorded a slight downward path since 2014. Finally, the education and innovation dimension shows the worst performance among all dimensions until the mid 2000s but increased markedly up to 2008, remaining stable afterwards.

Figure 4 presents the contributions of each dimension to the yearly changes in the indicator. Since all dimensions have a similar weight, these contributions are just one fourth of the yearly change, as presented in Figure 3. Nevertheless, the graph makes it clear that large changes in the composite indicator in specific years are typically attributed to a dominant contribution from a single dimension. The improvement in "Education and innovation" in 2008 is attributable to improvements in R&D indicators and the improvement in "Macroeconomic stability and income distribution" in 2018 is attributable to an improvement in the fiscal balance.

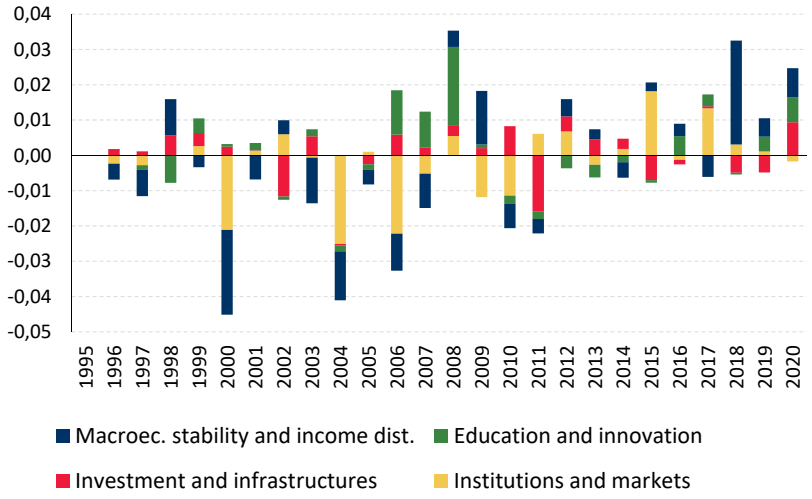

FIGURE 4: Contributions to changes in the composite competitiveness indicator

Figures 3 and 4 make the point that underlying competitiveness drivers have a quite different dynamics. In this context, the use of different weights for each one of them could affect the results and conclusions. However, the exercise associated with the recalculation of the ICC for a random set of weights, and the subsequent calculation of a robustness band, shows that the overall conclusions are not altered. As depicted in Figure 2, these bands are not very wide, the indicator stays always at low levels and its path is consistent with some improvements in the latest years. The four panels in Appendix B present the path of each dimension of the composite indicator, together with their respective robustness bands. In all cases the bands are quite narrow and the interpretations made above remain unaltered.

Figure 5 presents the values of the different pillars in each of the four dimensions of the composite indicator, as listed in Table 1, for the years 1995, 2007 and 2020. There was an improvement in all pillars from 2007 to 2020, except in "Investment"

and "Market dimension". Nevertheless, only "Institutions" achieved a score above 0.5 in 2020. Moreover, despite the substantial improvements in Portuguese qualifications in the last decades, "Education" has the lowest score among the entire set of pillars because other EU countries have also improved their educational outcomes. Conversely, "Innovation" has recorded sharp improvements and stands in 2020 as the second pillar with the highest score, below "Institutions" and close to "Labour market efficiency". "Income distribution" has also recorded strong improvements in the latest period.

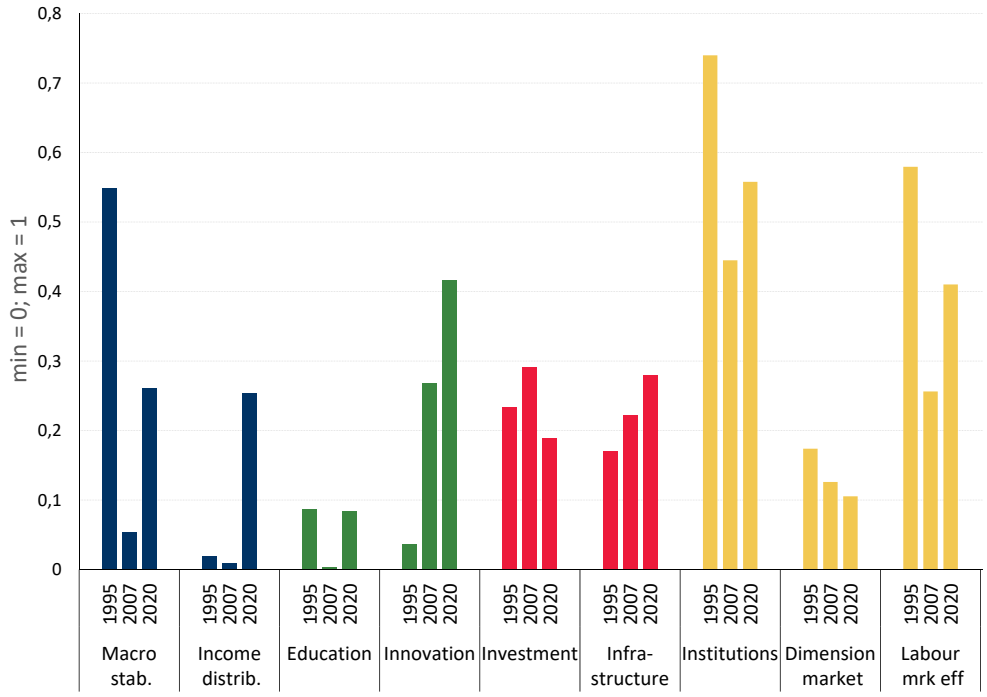

FIGURE 5: Pillars of the composite competitiveness indicator

3.2. *International comparison*

The composite competitiveness indicator presented above can be calculated in a similar way for other EU Member-States. Consequently, it is possible to make direct cross-country comparisons. This advantage derives both from the use of comparable data for all indicators, within the same time interval, and from the relative nature of the composite indicator, i.e., the fact that it is based on the distance relatively to the best performer within the reference group.

Figure 6 presents the level of the ICC for EU countries in the years 2007 and 2020. Sweden, the Netherlands and Denmark are the countries with highest values in 2020, reaching a level close to 0.8. Conversely, Greece, Italy and Croatia are the three countries with the lowest levels in the composite indicator in 2020. It should be noted that this ranking must take into account the absence of countries for which it was not possible to compute the indicator in these years due to lack of data. This was the case of Cyprus, Malta and Romania. Portugal ranks in the bottom tier (21st) but records the greatest progress among the reference group, as compared to 2007, the year immediately before the start of the economic and financial crisis. Poland and Ireland also record significant

progress from 2007 to 2020, while Finland, Denmark, France and Spain record the largest reductions.

Figure 7 shows the yearly path of the ICC for a selected group of EU countries that are either similarly sized or stand as important Portuguese trade partners. The figure shows great stability in the level of the ICC over the period considered. This is not a surprising result because competitiveness and its drivers are mostly structural variables, thus changing slowly over time. Within this set of countries, two exceptions to this broad stability are the Czech Republic and Austria, that have recorded sustained improvements in competitiveness.

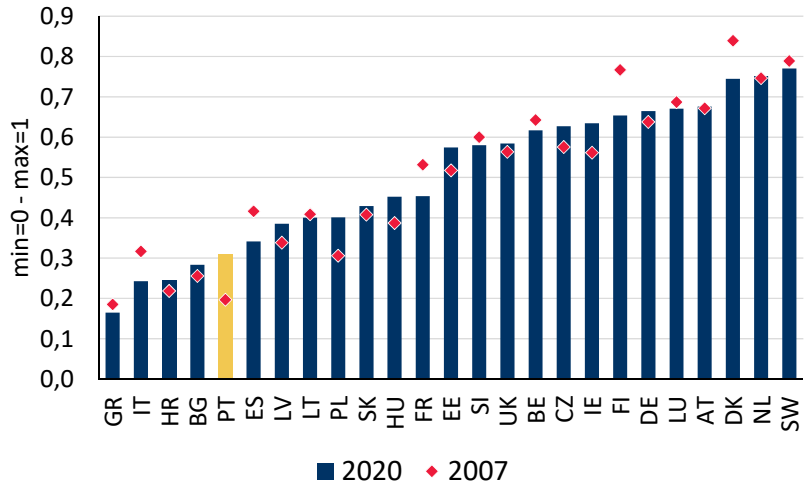

FIGURE 6: Composite competitiveness indicator in EU countries

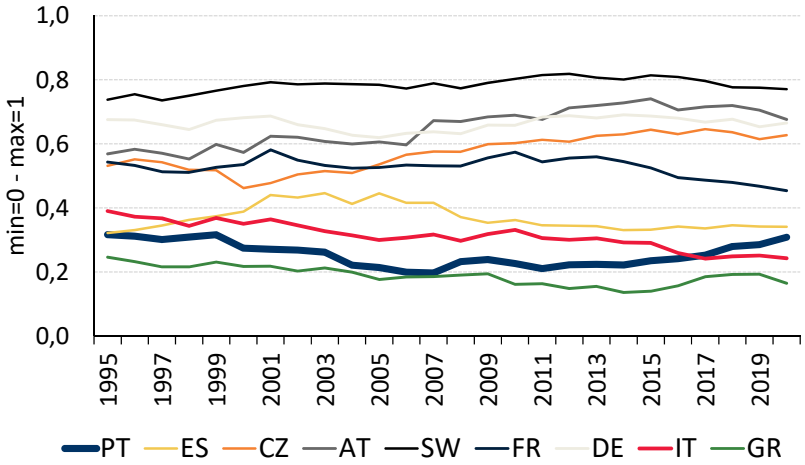

FIGURE 7: Dynamics of the composite competitiveness indicator in selected EU countries

3.3. Competitiveness, labour productivity and GDP per capita

In this subsection we compare the path of the ICC with that of three outcome variables: relative labour productivity per worker, relative labour productivity per hour worked

and relative GDP per capita. In order to have a meaningful comparison, those variables are transformed using the *"min-max"* method, i.e., defined in terms of deviations to the best performer in the reference group. One initial consideration to make relates to the nature of this comparison and its limitations. The economic system is complex and it is obvious that gains in competitiveness translate into higher productivity and GDP per capita, which influence back the path of the indicators used to assess competitiveness in the first place. One example is the impact of higher GDP levels on the denominator of several indicators used to assess competitiveness (e.g. Net savings, R&D expenditure, adjusted GFCF). This circularity makes us question the benefit of comparing the ICC with the above-mentioned outcome variables. In addition, there may be little benefit in assessing competitiveness conditions if the outcome variables are already observable. Nevertheless, there are clear advantages in the comparison between the ICC and the outcome variables. The ICC includes many variables with a structural nature, thus it is not affected by cyclical developments in the same way as GDP per capita or productivity. Therefore, deviations between the indicators may indirectly signal gaps of GDP and productivity from their potential. Moreover, it is possible to assess which dimensions of the ICC are more tightly associated with the path of the outcome variables.

Figure 8 compares the path of the ICC with the one of relative productivity per worker, relative productivity per hour worked and relative GDP per capita, taking an index based in 1995. The ICC and productivity per worker recorded a quite similar evolution until 2014. After that year, which corresponds to the end of the economic and financial assistance program in Portugal, the competitive conditions improved but relative labour productivity maintained a downward trend up to 2020. The comparison of the ICC with productivity per hour worked signals a decoupling starting at the beginning of the great economic and financial crisis in 2008. As for the comparison with the GDP per capita, again expressed in terms of distance to the best performer in the benchmark group, we also observe a decoupling after 2010 that continues up to 2020.

In this context, it is useful to compare the path of the ICC and relative productivity per worker in other EU countries. The results are presented in Appendix C and show quite different realities. The better performance of the ICC versus the relative labour productivity is also visible in Spain, the Czech Republic and Austria, and more mildly in Germany and the Netherlands. In all these cases the decoupling started earlier than in Portugal and it is associated to an underlying reduction in productivity. In this group, only in Austria and the Czech Republic the ICC shows an upward trajectory in this period.

It should be noted that the evolution of the index for the relative productivity in Portugal is quite negative and only comparable to that of Greece. This evolution results from a combination of relatively low productivity growth rates and a low starting value for productivity, which leads to a widening of the gap versus the best performing country.

Different explanations can be put forward for the sharp decoupling of the ICC versus the outcome variables in the most recent period in Portugal. One possibility is the underestimation of GDP growth in the latest years. This thesis can be supported by upward revisions in official Portuguese GDP growth rates in the latest years.

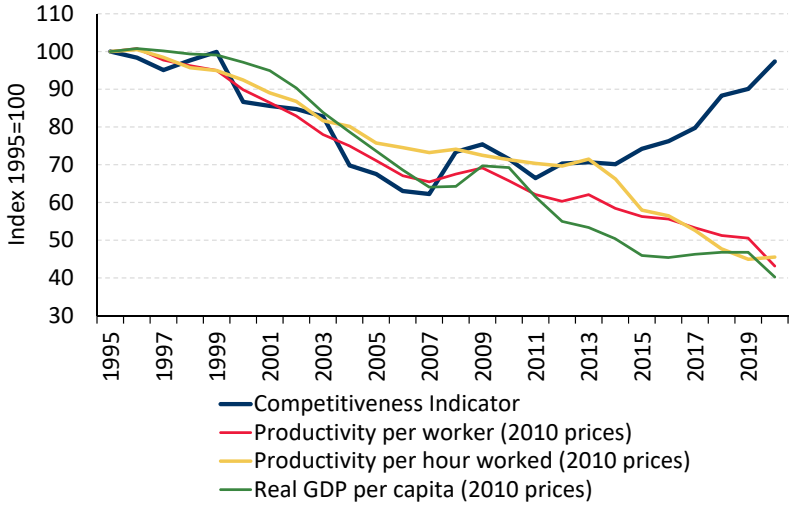

FIGURE 8: Composite competitiveness indicator, relative labour productivity and relative GDP per capita

Note: Labour productivity and GDP per capita, source Eurostat. Similarly to the ICC, relative labour productivity and relative GDP per capita are computed as deviations to the best performer as a percentage of the distance between the best and worst performers, also correcting for extreme values by using the percentiles 90 and 10.

However, this could hardly be the only explanation. Another explanation may be the incompleteness of the composite indicator in terms of dimensions or indicators to capture the full underlying competitive conditions of the economy. A third explanation is that aggregate labour productivity and GDP post cyclical fluctuations, while composite competitiveness indicators have a more structural nature. Therefore, the gap between the two series is reflecting a deviation of activity and productivity relatively to their true potential. However, the observed divergence for long periods of time in other countries reduces the likelihood of this explanation.

A final consideration relates to the possibility of using different outcome variables, which would presumably have a tighter connection with competitiveness developments. One possibility would be the market share of exports in world trade. However, this series raises problems in terms of controlling for the relative size of the countries and results would be seriously biased due to different import content in exports across countries, associated to uneven levels of integration in global value chains (GVCs). Considering the current account balance as an outcome variable is not a solution either. Beyond being difficult to assess the conditions under which a current account deficit (or surplus) is benign or malign, it relates to the net savings indicator in the macroeconomic stability and income distribution dimension, vividly reminding us of the above mentioned circularity of the exercise.

4. Final remarks

The analysis of the underlying competitive conditions across countries is an important and complex topic. The main difficulty lays on the definition of this concept. Beyond the

multiplicity of dimensions underlying competitiveness, there are difficulties in having relevant indicators that are both comparable between countries and available with a large time horizon. Additionally, it is necessary to aggregate the various dimensions of analysis into a synthetic indicator, which arises issues about weighting procedures.

Our work seeks to contribute to this debate, adopting specific solutions for the difficulties mentioned. Results obtained point to a modest performance of competitiveness in the Portuguese economy in the recent decades. The level of the indicator in 2020 is similar to that observed in 1995 and remains near 0.3 in a maximum score of 1. In terms of ranking within the set of EU countries the Portuguese economy is placed in the bottom group. Nevertheless, it is worth noting that in the latest years the performance has been positive. Developments in dimensions "Macroeconomic stability and income distribution" and "Institutions and markets" support these improvements. Results for 2020 are also encouraging, signalling that the COVID-19 pandemic may not have hurt Portuguese competitiveness in its initial year.

Our article offers a diagnosis procedure for competitiveness in the Portuguese economy that will hopefully enhance public discussion and improve decision-making. Similar analysis are also possible for other EU countries. Finally, given the complexity of the topic, it is important to underline that results are, even more than usually, open for debate. A full acknowledgment of the weaknesses and caveats of the exercise is the starting point for future work.

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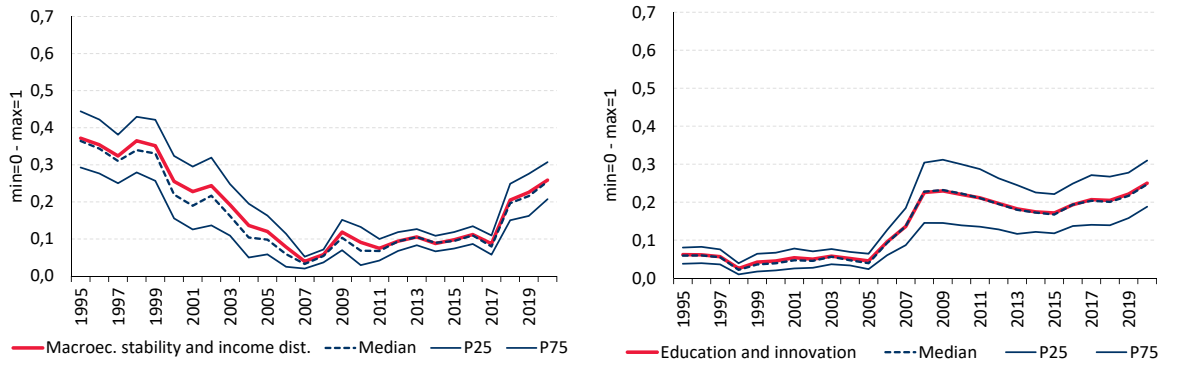
Appendix A: Alternative indicators

Indicator	Source	1st year
Macroeconomic stability and income distribution		
Cyclically adjusted budget balance	AMECO	2010
Nominal unit labour costs	Eurostat	1995
Net international investment position % GDP	Eurostat	1995
Income distribution		
Income quintile share ratio for disposable income	Eurostat EU-SILC	2003
Income quintile share ratio for gross market income	Eurostat EU-SILC	2010
Income quintile share ratio for net market income	Eurostat EU-SILC	2010
Income quintile share ratio for gross total disposable income	Eurostat EU-SILC	2010
Education		
PISA scores	OECD	2000
High-skilled Population	Eurostat	2004
Adult participation in learning % of pop. 25 64	Eurostat	2004
Pop +18 participation in educ. and training	Eurostat	2004
Employment by educational attainment level	Eurostat	1998
Employment +18 participation in educ. and training	Eurostat	2004
Employment by educ. attainment and socio-economic group	Eurostat	2011
Investment		
FDI % GDP	Eurostat	1995
FDI Regulatory Restrictiveness Index	OECD	1997
Stock of loans for non-financial corporations - total	Eurostat	1995
Infrastructure		
Air transport, freight	Eurostat	1995
Air transport Infrastructure	Eurostat	2001
Efficiency of air transport Services	WEF - Executive Survey	2014
Air connectivity index	International Air Assoc.	2007
Maritime transport	Eurostat	1997
Liner shipping connectivity Index	UNCTAD	2004
Efficiency of seaports	WEF - Executive survey	2014
Efficiency of train services	WEF - Executive survey	2014
Quality of roads	WEF	2016
Goods and services market		
Doing Business indicators	World Bank	2005
Product Market Regulation	OECD	1998
Economic Complexity Index	Harvard Growth Lab	1995
Services Trade Restrictiveness Index	OECD	2014
Electricity prices for household consumers	Eurostat	2007
Electricity prices for non-household consumers	Eurostat	2007
Gas prices for non-household consumers	Eurostat	2007
Financial market		
Financial Soundness Indicators	IMF	2003
Factors limiting the Production (Industry) - Financial	Eurostat	2001
Factors limiting the Business (Services) - Financial	Eurostat	2001
% of firms with access to finance as a major constraint	World Bank	2005
Labour market		
% 20-34 neither in employment nor in education and training	Eurostat	2006
Labour market slack [15-74]	Eurostat	2008
Factors limiting the business (Services) - Labour	Eurostat	2001
Employment Protection Legislation	OECD	1995

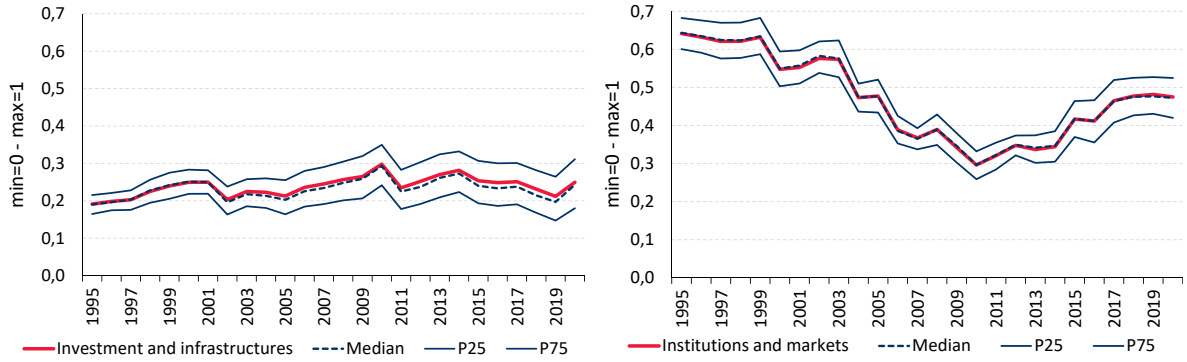
TABLE A.1. List of indicators considered but not selected

Note: Series not included because they start after 1995, or have many missing countries in initial years or their underlying interpretation is dubious.

Appendix B: Robustness of the composite competitiveness indicator for different weights



(A) Macroeconomic stability and income distribution (B) Education and innovaton

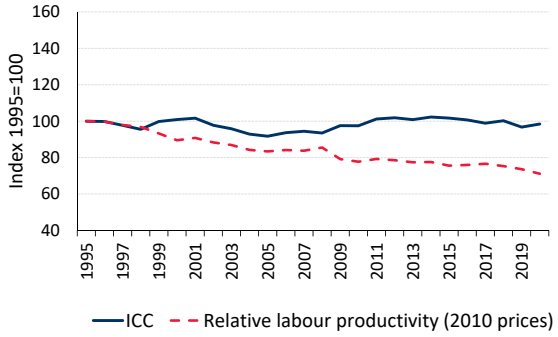


(C) Investment and infrastructure (D) Institutions and markets

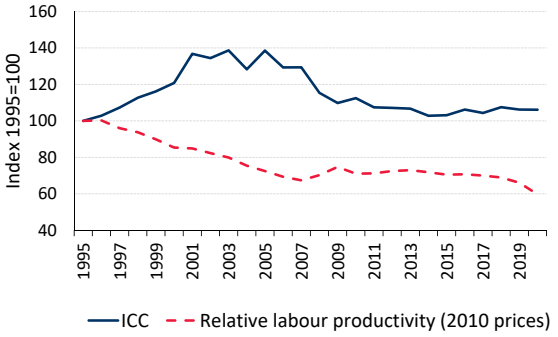
FIGURE B.1: Dimensions of the composite competitiveness indicator - Robustness

Note: The ICC dimensions are computed with uniform weights for each indicator. The median, and the percentiles P25 and P75 are obtained from the distribution that results from their calculation with 1000 random draws of weights, using a uniform distribution.

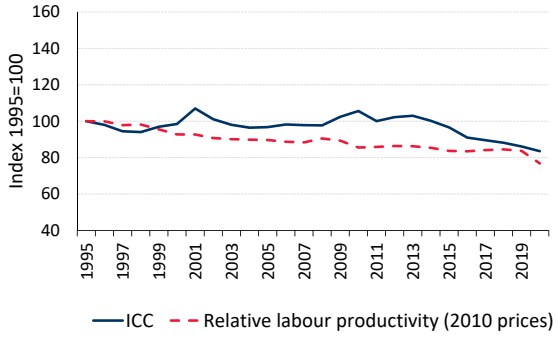
Appendix C: Composite competitiveness indicator and labour productivity in selected EU countries



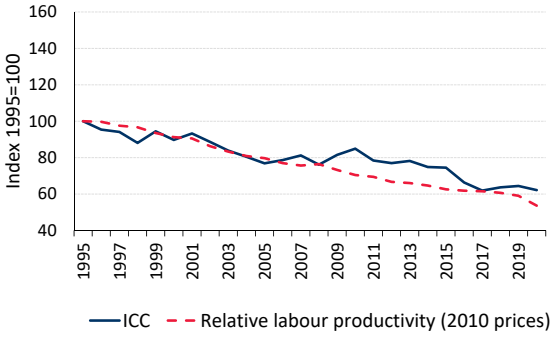
(A) Germany



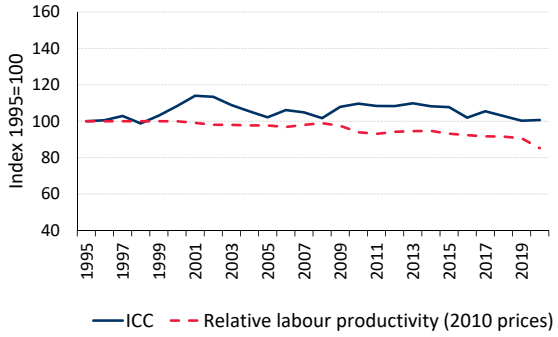
(B) Spain



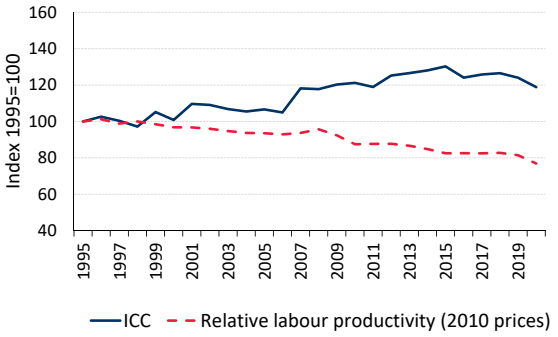
(C) France



(D) Italy

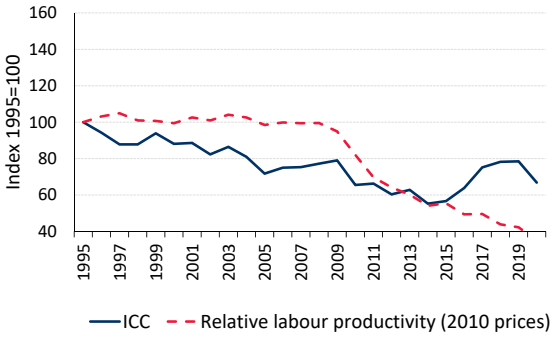


(E) Belgium

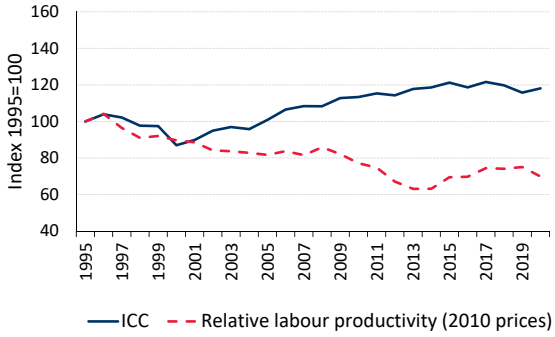


(F) Austria

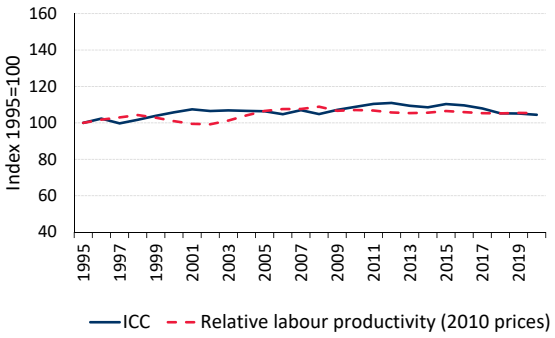
FIGURE C.1: Composite competitiveness indicator and productivity - Selected EU countries



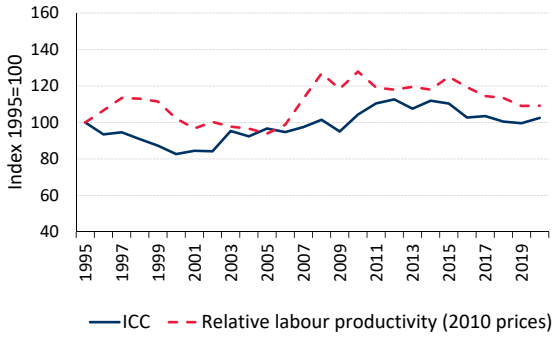
(G) Greece



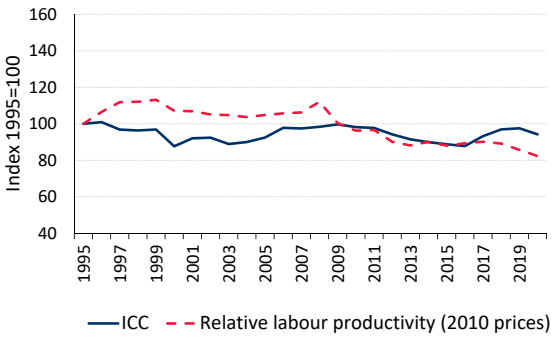
(H) Czech Republic



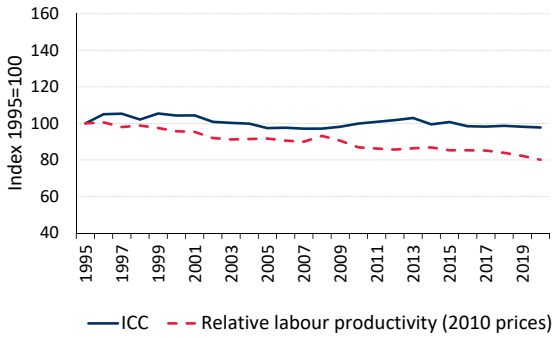
(I) Sweden



(J) Slovakia



(K) Slovenia



(L) Netherlands

FIGURE C.1: Composite competitiveness indicator and productivity - Selected EU countries